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Surgical site infection requiring hospitalisation unchanged with a prophylactic incisional negative pressure wound therapy guideline: an observational cohort study.

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ABSTRACT:

Background: Despite numerous published prospective studies, evidence to support use of prophylactic incisional negative pressure wound therapy, for obstetric and gynaecologic surgery, is conflicting.

Aim: To evaluate if wound-related presentations to hospital were reduced following introduction of a guideline promoting selective use of prophylactic incisional negative pressure wound therapy.

Methods: This was an observational cohort study. Electronic medical records were reviewed for all hospital presentations, within 30 days of primary surgery performed by laparotomy, where the responsible clinician was an obstetrician or gynaecologist. Rates of wound complications and costs associated with admission were compared pre- and post-guideline.

Results: Among all those who underwent caesarean birth (n = 2788) or gynaecologic laparotomy (n= 263), 5% presented to hospital with SSI, and 1% with non-infected wound problems. No significant reductions in SSI hospital presentations, length of stay, or readmission costs were observed post-implementation. Likewise, no improvements were observed for non-infected wound problems or a composite of SSI and non-infected wound problems.

Conclusions: This study does not support the selective approach used to direct prophylactic incisional negative pressure wound therapy. Further studies are required to better individualise risk assessment, and to determine if negative pressure wound therapy can reduce serious morbidity of SSI. When robust evidence is lacking, local outcomes should be evaluated systematically and reviewed before new treatments become standard care.

Key words: negative-pressure wound therapy, surgical wound infection, caesarean section, laparotomy

INTRODUCTION

Surgical site infection (SSI) following caesarean birth and gynaecologic laparotomy, is common and associated with morbidity, hospital admission, and treatment expense.[1-3] Preventing infection after surgery is a key priority of the New Zealand Health Quality and Safety Commission.[4]

An emerging strategy aimed at improving surgical wound healing and reduction of SSI is prophylactic incisional negative pressure wound therapy (piNPWT). This technology uses a single-use suction pump, tubing, and permeable surgical dressing to remove excess exudate and reverse interstitial oedema, to promote wound healing.[5] Compressional mechanical forces, as well as generation of a hypoxic gradient may also contribute to enhanced cell recruitment, proliferation and differentiation, leading to

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neovascularisation and granulation tissue formation. Cytokine and growth factor expression changes have been characterised in the presence of negative pressure wound therapy, altering angiogenesis, extracellular matrix remodelling and deposition of granulation tissue.

Recently, two large meta-analyses of piNPWT use in caesarean birth have been published with conflicting conclusions.[6-7] Yu *et al* included randomised controlled trials (RCT) and cohort studies, where entry criteria was predominantly related (but not limited) to obesity. This analysis showed piNPWT was associated with reduced SSI (11% to 5%, RR 0.45, CI 0.31-0.66, NNT = 17) and a composite of wound complications (RR 0.68, 95% CI 0.49–0.94). Smid *et al* included only RCTs where entry criteria was BMI >30 kg/m^2, and concluded that the evidence does not support piNPWT for wound infection (10.8% vs 8.3%, RR 0.79, 95% CI 0.44-1.41), or a composite outcome of wound complication prevention in patients with obesity (16.8% vs 17.8%, RR 0.97, 95% CI 0.63-1.49). Following these meta-analyses, three RCTs of piNPWT versus standard dressing in those undergoing caesarean birth with obesity were published.[8-10] Again, results were conflicting with one suggesting a significant reduction in SSI with piNPWT (9.2% vs 4.6%)[8] and the others showing no difference in wound morbidity.

Whether piNPWT is beneficial when used in surgeries other than caesarean birth is also unclear. A 2016 systematic review across surgical specialties found potential benefit of piNPWT, but questioned cost-effectiveness and long-term implications, and did not support widespread use outside of a research context.[11] Despite subsequent meta-analyses suggesting a potential benefit for superficial SSI, there exists significant clinical and methodological heterogeneity amongst the included studies, making it difficult to draw recommendations specific to gynaecologic surgery.[12-13] Furthermore, the impact of piNPWT on deep SSI, cost/benefit, and patient-centred outcomes remains understudied.

In November 2018, despite a lack of compelling evidence of benefit, Counties Manukau Health introduced a local guideline promoting use of piNPWT (Smith & Nephew PICO) for SSI prophylaxis (the guideline). Whilst piNPWT was previously available for occasional use at clinician discretion, the guideline directed standardised use for all those undergoing caesarean birth or gynaecologic laparotomy with risk factors for SSI.

As RCTs and meta-analyses have not provided clear conclusions regarding efficacy or safety, this provided an opportunity to assess the impact of piNWT on important outcomes in a real-life setting. This study aimed to evaluate if presentations to hospital with surgical site infection, and non-infected wound problems, were reduced following introduction of a guideline promoting selective use of prophylactic incisional negative pressure wound therapy. Secondary objectives were to determine impacts on length of stay, admission costs, return to the operating theatre, minimally invasive radiological interventions, and treatment with antibiotics.

METHODS

The study design was an observation before and after cohort study.

Study setting

Counties Manukau Health provides publicly-funded secondary care services to an ethnically diverse (16% Māori, 22% Pasifika and 29% Asian) population of an estimated 601,000 people in South Auckland.[14] 36% live in areas classed as the most socioeconomically deprived, and 70% have a BMI >25 kg/m^2. Diabetes prevalence in adults is Pasifika (16%), Indian (11%), Māori (10%) and 6% in European/Other. In 2019, there were 6805 hospital births, of which 45% involved a BMI >25 kg/m^2. 35% were Pasifika and 20% Māori. 13.1% were standard primiparae. Hospital-based labour care is provided in 14 birthing rooms by 49 hospital midwives and 80 community lead maternity carers, with constant on-site obstetric support. There are 75 maternity beds for antenatal and postnatal admissions. Approximately 2500 acute and elective gynaecologic surgeries are performed annually.

Intervention

With introduction of the guideline, all those undergoing open abdominal surgery (including caesarean birth) would receive a low-risk or high-risk wound care bundle (**Table 1**). Prior to the guideline, all received the same low-risk wound care bundle, except for occasional use of piNPWT on a case-by-case basis. Both pre- and post-guideline, all patients received clipping of pubic hair, pre-incision prophylactic antibiotic administration, alcohol chlorhexidine skin decontamination, and Cavilon™ No Sting Barrier Film (3M Company). Skin closure was almost exclusively with subcuticular Monocryl (Ethicon) other than at midline laparotomy where staples were used.

Table 1: Wound care bundles used for open abdominal surgery.

	Criteria	Dressing
High-risk bundle	• BMI ≥40 kg/m^2 OR; • At least two of the following: o Diabetes o Autoimmune disorder o Haematological disorder o Immunosupression o Hypertension o ≥3 prior laparotomies o Prior wound infections o Pre-existing skin problems o Steroid or anticoagulant use within 48 hours o Emergency caesarean birth with any of: o Prolonged rupture of membranes ▪ Chorioamnionitis ▪ Prolonged labour with fetal scalp electrode use	piNPWT PICO dressing applied directly to closed wound
Low-risk bundle	• BMI <40 kg/m^2 AND; • One or none of the wound infection risk factors listed above.	Steri-Strips™ (3M Company) and OPSITE Post-op Visible dressing (Smith & Nephew)

BMI, body mass index; piNPWT, prophylactic incisional negative pressure wound therapy

The guideline was published and distributed in early November 2018. Stakeholders were notified of the guideline by email and algorithms posted on operating theatre walls. PICO application was demonstrated by Smith & Nephew representatives.

Data collection

A single investigator reviewed electronic medical records of all presentations to hospital within 30 days of open abdominal surgery, where the responsible clinician had been an obstetrician or gynaecologist. For clarity, most surgeries were performed by resident doctors, under a mixture of direct and indirect supervision. As it was expected that clinicians would take some time to familiarise themselves with the guideline (and dressing) when these were first introduced, a four-month washout period was used, with data collection limited to surgeries prior to (1 Jan 2018 – 31 Aug 2018) and following the introduction of the guideline (1 Jan 2019 – 31 Aug 2019). There were no other exclusions.

The study duration was thought to be adequate to observe a reducing trend in presentations with SSI, and would provide interim data for review of the guideline's impact 1 year after introduction. A similarly designed local surgical study of vaginal preparation prior to caesarean birth had demonstrated a reduction in SSI over a shorter time period, with fewer participants (personal communication).

Demographic data, operation performed, time to presentation, length of stay, piNPWT use, treatment details, and retrospectively identifiable risk factors for SSI were recorded in an Excel spreadsheet, de-identified and analysed in aggregate form. For patients with multiple re-presentations, data were summarised as a single event.

Total readmission costs for each patient were derived per national district health board costing standards. Financial data from the hospital general ledger was linked with direct patient activity data. Calculations included direct resource use, staffing, and indirect costs e.g., building depreciation and procurement.

Analysis

The primary outcome of interest was presentation to hospital within 30 days of primary surgery, with any SSI. The presence or absence of SSI was determined by review of clinical notes, radiology reports and laboratory results, and defined by the internationally accepted modified Centres for Disease Control and Prevention definitions of nosocomial surgical site infections.[15] Briefly:

> ***Superficial SSI***: Involves only skin/subcutaneous tissue of incision with

sheath intact and the patient has at least one of: pus present/draining, organisms isolated, pain/tenderness, localised swelling, redness, heat.

Deep incisional SSI: Involves the deep soft tissues of the incision (e.g., fascial and muscle layers) and patient has at least one of: pus present/draining, an abscess, or dehiscence with fever >38°C or localised pain/tenderness.

Organ/Space SSI: Involves any part of the surgical site excluding the skin incision, fascia and muscle layers, and patient has at least one of: pus present/draining, organisms isolated, an abscess. This includes endometritis and vaginal cuff infections. An organ/space infection that is draining through the incision is defined as a deep incisional SSI, as it is considered a complication of the incision.

Secondary outcomes were: return to theatre with a wound complication, interventional radiological procedure for a wound complication, treatment with antibiotics for any reason, non-infected wound complications (wound problems not meeting definition of SSI), readmission duration, and readmission cost. Post-operative complications managed without presentation to hospital were not included.

A run chart of hospital presentations with SSI per month was interpreted with shift, trend, and run rules to determine if a reduction in SSI was observed following guideline introduction.[16] Statistical analysis was performed using R v3.6.3 (The R Foundation). Numerical data were assessed for normality and reported as mean ± standard deviation, or median (interquartile range) as appropriate. Outcomes for the 8 months prior to the introduction of piNPWT, were compared with outcomes over 8 months after introduction (following a four-month washout period) using Wilcoxon rank-sum test. A p value of <0.05 was considered statistically significant.

Audit

To audit dressing use, random sampling was used to select 10% of caesarean births over the same pre- (1 Jan 2018 – 31 Aug 2018) and post- (1 Jan 2019 – 31 Aug 2019) guideline periods. All cases undergoing laparotomy for gynaecologic surgery over these time periods were audited. Clinical notes were reviewed to determine if criteria were met for piNPWT application, and the proportion of appropriately used piNPWT dressings in those eligible were calculated for each time period.

Ethics

Introduction of the guideline, and use of the PICO dressing, was decided upon by the Obstetric Clinical Practice Group at Counties Manukau Health, independent of, and prior to development of this study. The study was approved by the Central Health and Disability Ethics Committee reference 18/CEN/277. All relevant locality and ethical approvals were obtained. The audit component reported was approved by the University of Auckland Human Participants ethics committee on 19/11/2018 (ref 021825).

RESULTS

Caesarean birth

A total of 2788 patients underwent caesarean birth (1335 before, and 1453 after the introduction of the guideline). 48% involved obesity. Obstetric demographics are reported in **Table 2**.

Gynaecologic laparotomy

A total of 263 laparotomies were untaken (130 before the guideline, and 133 after), of which at least 47% involved obesity. Gynaecology demographics are reported in **Table 2.**

Audit of dressing use

The case notes of 260 caesarean births (n = 117 before, and n = 143 after guideline) and all gynaecologic laparotomies were reviewed (n=130, 133). For those with risk factors meeting the criteria for piNPWT having a caesarean birth, 6/32 (19%) and 24/46 (54%) received a piNPWT before and after guideline introduction, respectively. For those having a gynaecologic laparotomy meeting the criteria for piNPWT, 4/28 (14%) and 18/26 (69%) received piNPWT before and after guideline introduction.

Surgical site infection

Run chart analysis showed no change in monthly presentation rate with SSI (primary outcome), non-infected wound problems, a composite of SSI and non-infected wound problems, return to theatre, radiological intervention, or antibiotic use following the introduction of the guideline (**Table 3**). These findings were true for combined

Table 2: Characteristics of patients who underwent caesarean birth or gynaecologic laparotomy before and after implementation of the local prophylactic incisional negative pressure wound therapy guideline.
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	Caesarean		Laparotomy	
	Before	**After**	**Before**	**After**
n	1335	1453	130	133
Age (years)†	30 (26, 34)	30 (26, 34)	46 (40, 53)	47 (42, 55)
Gestational age at delivery (weeks)†	39 (38, 40)	39 (38, 40)		
BMI, n (%)				
Underweight (BMI <18.5)	17 (1)	16 (1)	0 (0)	1 (1)
Normal weight	377 (28)	358 (25)	17 (13)	12 (9)
Overweight (BMI 25 – 29.99)	322 (24)	349 (24)	21 (16)	29 (22)
Class 1 obesity (BMI 30 – 34.99)	242 (18)	285 (20)	22 (17)	29 (22)
Class 2 obesity (BMI 35 – 39.99)	183 (14)	209 (14)	17 (13)	20 (15)
Class 3 obesity (BMI 40+)	187 (14)	229 (16)	19 (15)	16 (12)
Unknown	7 (1)	7 (0)	34 (26)	26 (20)
Ethnicity, n (%)				
Māori	184 (14)	206 (14)	23 (18)	22 (17)
Pasifika	433 (32)	475 (33)	39 (30)	38 (29)
European	267 (20)	304 (21)	39 (30)	40 (30)
Indian	261 (20)	296 (20)	15 (12)	11 (8)
Asian	148 (11)	132 (9)	12 (9)	19 (14)
Other	42 (3)	40 (3)	2 (2)	3 (2)
SSI associations, n (%)				
Diabetes	225 (17)	269 (19)	20 (15)	15 (11)
Hypertension	165 (12)	190 (13)	7 (5)	14 (11)
Smoker	180 (13)	129 (9)	38 (29)	24 (18)
Primiparous	562 (42)	649 (45)		
Multiparous	773 (58)	804 (55)		
Surgery type, n (%)				
First stage emergency caesarean	840 (63)	936 (64)		
Second stage emergency caesarean	156 (12)	160 (11)		
Elective caesarean	339 (25)	357 (25)		
Abdominal hysterectomy			110 (85)	118 (89)
Abdominal myomectomy			9 (7)	2 (2)
Other laparotomy			11 (8)	13 (10)

BMI, body mass index; † Median (interquartile range

caesarean birth and gynaecologic laparotomy, as well as for caesarean alone, and laparotomy alone. Of those presenting with SSI following caesarean birth, 19% were elective, 11% emergency not in labour, 68% in the first stage of labour, and 21% in second stage. Following elective caesarean, there were 15 (4.4%) presentations with SSI before, and 11 (3.1%) after, introduction of the guideline. SSI presentations following emergency caesarean were 46 (4.6%) before, and 62 (5.7%) after guideline introduction

Table 3: Post-operative hospital presentation and treatment breakdown before and after implementation of the local prophylactic incisional negative pressure wound therapy guideline.

	Caesarean		Laparotomy		Combined	
	Before	**After**	**Before**	**After**	**Before**	**After**
Presentation reason, n (%)						
Presented for any reason	142 (11)	149 (10)	39 (30)	29 (22)	181 (12)	178 (11)
SSI	61 (5)	73 (5)	12 (9)	11 (8)	73 (5)	84 (5)
Superficial	37 (3)	45 (3)	7 (5)	10 (8)	44 (3)	55 (3)
Deep	6 (0)	6 (0)	2 (2)	0 (0)	8 (1)	6 (0)
Organ space	18 (1)	22 (2)	3 (2)	1 (1)	21 (1)	23 (1)
Wound problem (non-infected)	7 (1)	8 (1)	5 (4)	3 (2)	12 (1)	11 (1)
SSI + wound problems	68 (5)	81 (6)	17 (13)	14 (11)	85 (6)	95 (6)
Treatment, n (%)						
Antibiotics given	97 (7)	103 (7)	28 (22)	22 (17)	125 (9)	125 (8)
Return to theatre	12 (1)	11 (1)	2 (2)	2 (2)	14 (1)	13 (1)
Interventional radiology	3 (0)	1 (0)	0 (0)	0 (0)	3 (0)	1 (0)

BMI, body mass index; SSI, surgical site infection

The incidence of presentations, following caesarean birth, with SSI and non-infected wound problems are shown compared to the maternity population of the hospital catchment in **Table 4**.

Length of stay

A non-statistically significant reduction in median length of stay during readmission with SSI or non-infected wound complications was observed after guideline implementation. The most notable reductions were of median readmission durations with non-infected wound complications: 36 h to 5 h for caesarean birth (n = 15, p = 0.12), and from 115 to 22 h for laparotomies (n = 8, p = 0.57). Length of stay varied considerably from 3 h to 763 h.

Costs

Total readmission costs with SSI increased post-implementation (**Table 5**). The combined readmission costs for SSI and wound problems increased from $215,025 to $355,954, which does not include the $38,160 spent on piNPWT dressings post-implementation. No statistically significant differences in median costs of readmission were identified.

Table 4: Demographic associations with hospital presentation with wound complications following caesarean birth.

	Maternity population	**Caesarean birth**	**SSI**	**Superficial**	**Deep**	**Organ space**	**Other wound problems**	**Total**
Ethnicity, n (%)								
Māori	20%	390 (14)	25 (19)	22 (27)	1 (8)	2 (5)	0 (0)	25 (17)
Pasifika	29%	908 (33)	56 (42)	35 (43)	6 (50)	15 (38)	6 (40)	62 (42)
European/ Other	24%	571 (20)	16 (12)	8 (10)	2 (17)	6 (15)	2 (13)	18 (12)
Indian	14%	557 (20)	23 (17)	11 (13)	2 (17)	10 (25)	2 (13)	25 (17)
Asian	13%	280 (10)	10 (7)	4 (5)	0 (0)	6 (15)	2 (13)	12 (8)
BMI, n (%)								
<18.5	1%	33 (1)	1 (1)	1 (1)	0 (0)	0 (0)	1 (7)	2 (1)
18.5 – 24.99	25%	735 (26)	24 (18)	10 (12)	1 (8)	13 (33)	2 (13)	26 (17)
25 - 29.99	31%	671 (24)	24 (18)	12 (15)	2 (17)	10 (25)	3 (20)	27 (18)
30 - 34.99	20%	527 (19)	24 (18)	12 (15)	2 (17)	10 (25)	5 (33)	29 (19)
35 - 39.99	12%	392 (14)	21 (16)	15 (18)	2 (17)	4 (10)	1 (7)	22 (15)

40+	10%	416 (15)	40 (30)	32 (39)	5 (42)	3 (8)	3 (20)	43 (29)

BMI, body mass index; SSI, surgical site infection

Table 5: Costs of readmission with surgical site infection and non-infected wound problems before and after implementation of the local prophylactic incisional negative pressure wound therapy guideline.

Total readmission cost			
Caesarean	**Before**	**After**	**p†**
SSI	$201,528	$350,602	
Wound problem (non-infected)	$13,497	$5,352	
SSI + wound problems	$215,025	$355,954	
Laparotomy			
SSI	$111,008	$94,769	
Wound problem (non-infected)	$34,339	$14,257	
SSI + wound problems	$145,347	$109,027	
Combined			
SSI	$312,536	$445,371	
Wound problem (non-infected)	$47,836	$19,609	
SSI + wound problems	$360,372	$464,980	
Median readmission cost			
Caesarean	$1,825	$2,125	0.73
Laparotomy	$5,390	$5,335	0.80
Combined	$2,227	$2,558	0.91

SSI, surgical site infection. Costs are in New Zealand Dollars.
† Independent Wilcoxon rank-sum test of median values

DISCUSSION

Introduction of a guideline promoting liberal use of piNPTW at a large public hospital was not associated with reduced hospital presentation rates with SSI, non-infected wound problems, length of hospital stay, nor cost of readmission. These findings suggest that promoting and guiding piNPWT use has not improved severe outcomes in a high-risk population. Although substantial reductions in length of stay were observed in readmissions with non-infected wound problems, this was not statistically significant, and the absolute number of these presentations was small (12 pre-, 11 post-guideline), so underpowered to detect a statistically significant difference. It is plausible that piNPWT may reduce the severity and/or length of stay for wound complications absent of infection. However, with a 1% presentation rate, a large study would be required to detect a difference, and the number needed to treat would be high.

A single-use PICO piNPWT dressing pack costs $200, compared with $4.03 for a standard 20 cm OPSITE Post-op Visible (Smith & Nephew) dressing. With no observed readmission cost reduction, piNPWT had an absolute cost of $38,160 over eight months post-implementation. With an absence of evidence of benefit of piNPWT, the additional cost presents a demonstrable harm that must be considered when evaluating the role piNPWT outside of a research context. Additionally, because PICO dressings are kept in place for 7 days and are costly to replace, diagnosis of infection could be delayed if these reasons prevent earlier removal of the dressing for examination of the wound.

There are several reasons that may explain the lack of benefit to wound outcomes observed in this study. Firstly, despite high rates of obesity, rates of wound complication were approximately one third to one half of that reported in systematic reviews. While the total number of complications may be underestimated (as presentations to primary care were not recorded), it is the rates of wound complication that require admission for assessment or treatment that are of most significance to clinicians and affected patients. Neither length of stay, nor admission cost reduced post-guideline

release. These are indicators of SSI and wound complication severity and suggest that the most severe wound complications were not affected by introduction of the guideline.

Secondly, uptake of the guideline by clinicians was incomplete, though an audit of piNPWT use over the same period as the current study demonstrated a statistically significant increase in piNPWT use in patients who were eligible by guideline standards. This highlights both the challenges of translating clinical research findings into practice, and importance of developing an implementation and measurement strategy when new guidelines are released.

Finally, it is possible that a population may exist for whom piNPWT is beneficial, but that is not described by established risk factors. In this study, risk factors for SSI included obesity, diabetes, hypertension, and pyrexia in labour, as these were over-represented in SSI presentations compared to baseline rates. Rates of SSI were higher for emergency caesarean birth, especially in the second stage of labour. Compared to other ethnic groups, Pasifika patients were more likely to birth by caesarean, and more likely still, to develop SSI (**Table 4**), with elevated BMI and diabetes being the predominant risk-factors in this population. Individualising risk assessment using perioperative variables and ethnicity may lead to a more targeted approach to piNPWT and is an area that requires further research.

Strengths include the large number of patients undergoing surgery, and the evaluation of real-world clinical practice, using an intention-to-treat design. While randomised trials are the gold-standard, the populations studied often differ from Pacific settings, and practice is also likely to differ when in the narrow confines of a research setting. This means that evaluation of actual use should also occur concurrently to inform clinicians, patients, and other stakeholders.

There are several limitations to this study. Due to the retrospective design, there may be factors contributing to SSI that changed during the study period, which are unaccounted for. Any patients presenting to primary care or other hospitals and not transferred to Counties Manukau within 30 days of the primary surgery, would not be identified in this analysis. BMI was not recorded for 23% of gynaecology patients. Medical co-morbidity identification was limited to that entered into the electronic clinical records. Resident doctors went on strike in early 2019 over 13 days, which may have increased the proportion of surgeries performed by a more senior clinician, and may have delayed some elective procedures. There was a 9% increase in the number of caesarean births performed after guideline release (**Table 2**). While possible that a small reduction in SSI and wound complications may have been masked by the increased number of caesarean births, the total number of SSI presentations increased by 20%, and the SSI and wound complication rates remained unchanged at 5% and 1% respectively.

Following this analysis, the largest study to examine the use of piNPWT in patients with obesity undergoing caesarean birth was published.[17] With a goal to recruit 2850 participants, this RCT was terminated after interim analysis of 1625 participants due to a low power to detect a significant difference in SSI, and concern over increased adverse skin reactions in the piNPWT group. Subsequently, the largest RCT of piNPWT for gynaecologic laparotomy, of 505 patients undergoing abdominal hysterectomy for malignancy compared universal piNPWT to standard dressings.[18] No difference in wound complications was identified between groups (17.3% vs 16.3%), nor when stratified by BMI. Skin blistered occurred in 33 patients (13%) in the piNPWT group and in three patients (1.2%) in the standard dressing group (p = 0.001).

CONCLUSION

Surgical site infection is an important cause of morbidity after caesarean and gynaecologic laparotomy. There is a lack of compelling evidence of benefit, and a paucity of safety data on piNPWT in these surgeries, however piNPWT remains a popular addition to the SSI reduction bundle in many hospitals. This study does not provide support for the piNPWT guideline implemented at Counties Manukau, and further research to better individualise risk and triage use of new devices is required. This should be followed by development of local implementation strategies and systematic review of local outcomes before they are recommended as standard care.

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Conflicts of Interest

The authors declare no interest or relationship, financial or otherwise that might be perceived as influencing objectivity.

Author Contributions

SH developed the methodology, arranged ethics and locality approvals, collected the data, performed the analysis, and drafted the manuscript; SA performed analysis and assisted with writing the manuscript; ST conceived the research question and assisted with writing the manuscript; CO supervised the study and associated audit, performed analysis, and assisted with writing the manuscript.

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